

THE ANT FAUNA NEAR THE TREE-LINE IN NORTHERN QUÉBEC (FORMICIDAE, HYMENOPTERA)

André FRANCOEUR

Laboratoire de biosystématique
Université du Québec à Chicoutimi,
Québec G7H 2P9, Canada

Abstract

Specimens collected during recent surveys show that the ant fauna of regions adjacent to the tree-line in northern Québec includes at least five established species. An additional species is represented by queens only at Poste-de-la-Baleine. The ant *Leptothorax acervorum*, known up to now as an exclusive palearctic element, is recorded for the first time from North America. The available data on the ecology and the range of this particular insect fauna are discussed for the eastern part of the nearctic forest-tundra ecotone.

Résumé

Des échantillonnages récents effectués au Québec montrent que la myrmécofaune de régions adjacentes à la limite nordique des arbres se compose d'au moins cinq espèces bien établies. Une espèce additionnelle est représentée seulement par des reines, à Poste-de-la-Baleine. La présence surprenante de *Leptothorax acervorum*, une forme jusqu'à présent connue uniquement de la région paléarctique, est signalée pour la première fois en Amérique du Nord. On discute les données disponibles sur l'écologie et la répartition de cette faune particulière d'insectes pour la partie orientale de l'écotone néarctique forêt-toundra.

Introduction

It is generally stated and accepted that ants cannot maintain colonies very far beyond the northern limit of trees in North America (Wilson, 1971). Since Parry in 1826 recorded the abundance of one species, under the name of *Formica rubra*, at the Whale-Fish Islands and the Melville Peninsula (cited by Weber, 1953), no well established colony has apparently been recorded so deeply inside the nearctic tundra. Modern observations concern the forest-tundra ecotone (Brown, 1955; Gregg, 1972) which stretches out as an extremely irregular boundary, penetrating inland in some places, especially along river valleys. Occasionally isolated workers or alate females and males have been captured many kilometers deep in the tundra biome (Brown, 1955; Weber 1950). They had probably been dispersed by winds or driftwood.

This northern picture of the nearctic myrmecofauna is derived from very limited, sporadic and unchecked data. It appears that the ant components of biocenoses adjacent to both sides of the tree-line still remain very poorly known as a whole from taxonomic, ecological and biogeographical points of view. This holds true in particular for the involved forest and shrub tundra in northern Québec. Fortunately, recent data acquired through general collecting in some localities, along with some older

series, provide new and significant information on northern ants. They are compared with those published by Gregg (1972) for Churchill, Manitoba, on the western side of Hudson Bay. Such knowledge is also needed to support a sounder interpretation in paleoecological studies of ant subfossils in Holocene deposits.

Available data

Table I gives the species recorded and the number of samples available for the present analysis. Series were collected by myself in the mentioned localities, except Rivière-à-l'Eau-Claire, during a week stage in 1980 and 1981. Others were supplied by two colleagues of Université Laval, Drs. Serge Payette and J.-M. Perron, or were found in the insect collection of Université de Montréal (one sample) and in the Canadian National Collection (two samples). Most series discussed hereafter are represented by specimens in the author's collection.

The name of Fort-Chimo includes Stewart Lake and Old Chimo Village areas. Samples from Lac Guillaume-Delisle (Richmond Gulf) were collected in three different sites: Le Goulet, Parnassie Island and near the mouth of the Ouïatchouan River.

Relevant data on the species included in this review are summarized as follows.

TABLE I

Ant species collected in areas adjacent to the tree-line in northern Québec (forest tundra) and Churchill, Manitoba (A, forest tundra; B, shrub tundra)¹

Species	Localities				
	Québec				Manitoba
	Fort-Chimo (58°40'N - 68°24'W)	Rivière-à-l'Eau-Claire (56°13'N - 76°01'W)	Lac-Guillaume-Delisle (56°13'N - 76°17'W)	Pointe-de-la-Baleine (55°17'N - 77°45'W)	Churchill (58°47'N - 94°11'W) A B
<i>Myrmica alaskensis</i>	1			7	3
<i>Leptothorax acervorum</i>	2	1	7	1	5
<i>Leptothorax muscorum</i>	7		6	6	4
<i>Camponotus herculeanus</i>	1	1	2	2	9
<i>Formica neorufibarbis</i>	7	1	1	21	5
<i>Formica subnuda</i>				7	3

¹ The data from Churchill were published by Gregg in 1972. Figures indicate the total numbers of different (mostly colonies) samples available.

Myrmica alaskensis Wheeler

This *Myrmica*, previously called *kaschei* Wheeler (Creighton, 1950), was found nesting in organic and mineral soil within a small hummock of *Polytrichum* sp. or in dead wood, such as decaying stumps covered by mosses. Larvae, prepupae and pupae were abundant. Colonies usually occupy microhabitats which retain a minimum of humidity during the short growing season. Habitats: Wet hollow with shrubs, shrubby thickets (with *Betula glandulosa* Michx., *Ledum groenlandicum* Oeder, lichens and mosses), old logged open forest with spruce and tamarack. That ant was recorded in similar situations at Churchill, Manitoba, under the name *M. brevinodis* by Gregg (1972) (specimens examined). It occurs throughout the boreal coniferous forest from Alaska to Labrador (unpublished data).

Leptothorax acervorum (Fabricius)

The occurrence of this species in Québec is recorded here for the first time and represents an addition to the list published by Francoeur (1977). Discovered in such widely separated localities as Fort-Chimo and Poste-de-la-Baleine, it could presumably be widespread along the tree-line. The inland record of Rivière-à-l'Eau-Claire suggests such an interpretation. Observed colonies appeared prosperous with brood; adult populations averaged 45 workers with one or many queens. Eight of the thirteen complete colonies collected were polygynous. Nests were built in soil under stones, in small and dry pieces of dead trunks, and in dead roots and twigs partially buried under mosses. Habitats: rocky outcrops with muskeg, old logged stand of spruce and tamarack, disturbed rocky coastal bluff with dwarf birch, *Elymus* strips near water, and balsam poplar stand. Gregg (1972) did record *L. acervorum* in the shrub tundra of Churchill area, but under the name *L. canadensis kincaidii* Pergande (specimens examined). Workers of this species were also kindly provided from the same area by Dr. S.A. Elias. This comparatively large *Leptothorax* is easily recognized

by the shape and size of the postpetiole and the numerous suberect appendage hairs in all castes.

In Québec, colonies exhibit ecological characteristics similar to those of populations in Europe, where nests are also found in peat of open moorland and rock crevices in the northern part of the species range (Bolton and Collingwood, 1975; Collingwood, 1979).

Leptothorax muscorum (Nylander)

Brown's (1955) study on the taxonomy of lower taxa associated with the name *L. canadensis* Provancher, shows that these ants represent an holarctic species of boreal-alpine nature. It holds the northernmost record for the nearctic ant fauna: one living worker was collected at Kidluit Bay, on Richards Island, Northwest Territories of Canada (69°32'N, 133°47'W). This species of *Leptothorax* appears widely distributed throughout Québec from the south to the tree-line (unpublished data), assuming that only one biological entity is involved.

Colonies usually build their nests in pieces of dead, dry or decaying wood lying on the soil surface or partly buried, such as branches, twigs, tree roots, and under miscellaneous objects abandoned by man such as tin and boards. Nest populations can reach one hundred adults or more. Habitats: open spruce and tamarack stands, old logged areas, ruderal zones, rocky outcrops with dwarf birch and muskeg, *Elymus* strips near water. Gregg (1972) collected one colony under stones in tundra heath near Churchill, Manitoba.

Camponotus herculeanus (Linné)

In the areas explored I could not locate any colony, though a single stray worker was seen running on two different occasions. One dead dealated queen was found alone in a small cavity carved in dead wood. Old galleries in decaying trunks were observed four times.

Colonies nest in rotten logs and stumps, rarely in soil. Habitats: wooded sites and disturbed areas with pieces of

wood. Because of their habits as carpenter ants requiring wood for nesting material, they do not easily colonize the treeless tundra, although their populations are usually abundant in the nearby coniferous forest. Gregg (1972) recorded one colony in the tundra heath of Churchill, but found it more abundant in an undisturbed, rather dense, black spruce and tamarack forest.

Formica neorufibarbis Emery

Though mainly concentrated in sandy habitats, this ant appears most prosperous in the vicinity of the tree-line, either in terms of colony populations, which amount to a few hundred individuals, or in the numbers of colonies, particularly in open spruce-lichen formations. In the same kind of habitat much farther south, it is replaced by *F. podzolica* Francoeur as a dominant ant (Francoeur, 1973). The nests are most often constructed under stones of small to moderate size, and cushions of lichen, sometimes under miscellaneous objects. Only three among the discussed samples were extracted from dead wood (log and stumps). Habitats: sandy terraces with dwarf birch thickets and stones or open spruce-lichen formations, *Elymus* strips along water banks, rocky outcrops with shrubs. Gregg (1972) reported this form under the name *Formica neorufibarbis gelida* Wheeler (specimens examined).

When I was in Fort-Chimo the director of the experimental musk ox farm, Mr. H. Durocher, told me that once he observed the curious behavior of a black bear turning stones up in a sandy coastal terrace with dwarf birch thickets. He kindly agreed to take me to that place, located about one km east of Old Chimo Village, on the south bank of the Koksoak River. I discovered there a polygynous colony under almost every stone. Obviously the bear was looking for these ants as food. At that very place samples of live queens, workers and brood were taken from some colonies. Workers exhibited aggressiveness when the nest was disturbed. About two weeks later in my laboratory they were fused into two populations without problem. This could mean that the colonies prospering in that isolated place have developed a polycalocal population such as encountered in the *Formica rufa* group. If such an interpretation should be confirmed the *Formica fusca* group would also exhibit this biological feature. Polygynous colonies were also observed in most of the other sites.

In the Alpine Garden of Mt. Washington, New Hampshire, where an alpine tundra occurs, colonies with numerous small queens were collected by Brown and Wilson (Brown, personal communication), illustrating a similar situation and exhibiting a morphological trend associated with altitude (Francoeur, 1973). However the relations between colonies remain unknown in this case.

Formica subnuda Emery

Since Francoeur (1974) reported the presence of this species in Poste-de-la-Baleine based upon dealated

females, no additional data have been collected from the forest-tundra ecotone of northern Québec. Therefore, colony establishment has not yet been confirmed. However the species occurs in more southern zones of open spruce-lichen formations (unpublished data). The nearest known record comes from the northernmost jack pine stands (*Pinus banksiana* Lamb.) discovered by S. Payette on Little Whale River (55°2'N, 75°47'W). Creighton (1950) has stressed the transcontinental nature of the range of this species which extends into Yukon and Alaska.

Formica subnuda builds nests either with mineral or organic matter, in heavy or open deciduous and coniferous woods, or in fully exposed biotopes such as pastures. This active and aggressive ant frequently enslaves *Formica* species such as *subaenescens* and *neorufibarbis*. Despite the abundance of the latter, the absence of *F. subnuda* could mean that it cannot become permanently established near the tree-line in Québec. It was not recorded by Gregg (1972) from Churchill, Manitoba.

Discussion and conclusions

The northern ant fauna of North America was traditionally associated with only three species, under a number of different names (Brown, 1955; Weber, 1950 and 1953; Francoeur, 1973). Recently Gregg (1972) and Francoeur (1974) added a fourth species for both sides of Hudson Bay. The list is here again enriched with another element, so that now five ants are known to occur and reproduce at or near the tree-line:

Myrmica alaskensis
Leptothorax acervorum
Leptothorax muscorum
Camponotus herculeanus
Formica neorufibarbis

These species, belonging to four different genera, compose the basic myrmecofauna best able to survive in the eastern part of the forest-tundra ecotone from Churchill, Manitoba to Ungava Bay, in Québec. They represent only two subfamilies of ants: Myrmicinae with the first three species (60%) and Formicinae with the last two (40%). *Formica subnuda*, which is not included here for reasons explained previously, belongs to the latter. The taxonomic diversity and the density of colonies remain rather reduced as compared to much richer faunas farther south. For example, such an impoverished remnant makes up only about 20% of the typical ant complement in the boreal coniferous biome of Québec (unpublished data).

Only *Leptothorax acervorum* seems restricted to the transition belt. Known up to now as a palaearctic form its occurrence in North America raises questions about the introduced or indigenous nature of its presence. Though limited, the actual data indicate a wide distribution not easily explained as an introduction. The discovery of this *Leptothorax* in the western part of the nearctic region would mean the ant is a true holarctic form.

In general the species encountered produce small colony populations, the largest being those of *Formica neorufibarbis*. The relative abundance near the tree-line of this ant and of *Leptothorax muscorum* indicates that they are probably the best fitted to achieve colony developments in the adjacent areas of the treeless tundra. Old records under such names as *Myrmica rubra* and *Formica rubra* should pertain to them when checked *in situ*. They also reach and invade the alpine tundra (Brown 1955; Gregg 1972; Francoeur, 1973). Such an adaptation to tundra habitats should also be found in the European *Leptothorax acervorum* because of its known biological and ecological characteristics. In Europe, it replaces *L. muscorum* in higher elevations on mountains (Bernard, 1968).

Frequent forest and shrub fires associated with tree-line dynamics in northern Québec should be considered as an important factor affecting the distribution, the abundance and genetic trends of these ant populations, which live in close association with the ground surface. Since the amount of radiant heat available at that level may be considered as a basic limiting factor (Brown, 1973), a correlation should be expected between the limits of ant ranges and the occurrence of permafrost. For example I could not find any ant in *palsa* bogs and in a spruce stand on frozen soil.

Though its scope still remains limited the present analysis of newly available and older reliable data produce a

more accurate picture of the ant fauna associated with the eastern part of the nearctic tree-line ecotone. The basic core of this insect community should also characterize the western counterpart. However, when fully known, some additional features either from taxonomic or ecological aspects will likely come to light because of peculiarities encountered in the Alaska and Yukon situation. These regions played an important role in the formation of refugia during the last glaciation period. Differences in the Pleistocene and post-Pleistocene history of the northeastern and northwestern lands of North America were recently up-dated by Matthews (1979). These differences have, no doubt, influenced the actual distribution of ants.

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